

Summary Report on India National Groundwater Meeting: Scoping a National Reform Agenda

Ministry of Water Resources, River Development & Ganga Rejuvenation

September 24, 2015, Venue: Le Meridien Hotel, New Delhi

BACKGROUND

India has extensive groundwater – the major aquifers of the Indo-Gangetic basin (spanning the Indus–Ganges–Brahmaputra rivers) are amongst the most productive in the world – and India is now the world’s largest user of groundwater (25% of global use), exceeding the combined groundwater use of China and USA (the 2nd and 3rd largest users). Its vast groundwater resources are a valuable hidden treasure, offering low cost, drought-resistant and generally high quality water supply to meet rural and urban demands, as well as sustaining valuable ecosystems. Groundwater supports river base-flows, wetlands and terrestrial vegetation. It is often the sole supply for people and livestock in arid and semi-arid regions.

Groundwater has delivered significant socio-economic benefits including greater domestic water security, enhanced food security and improved rural livelihoods. Around 62 percent of available groundwater has been developed on average, supporting 65 percent of irrigation and 85 percent of domestic water supply. Although there is potential to further develop the alluvial aquifers of the eastern and northeastern states, groundwater use is already unsustainable in many other parts of India with aquifer levels steadily declining and contamination widespread.

Intensive and unregulated groundwater pumping has caused rapid and widespread groundwater decline in many areas, including in the northern “bread basket” states where an estimated 15 percent of India’s food is produced by groundwater mining. Groundwater levels are falling in several major urban areas including Delhi, Jaipur, Mumbai, Ludhiana, Faridabad and Rajkot. In addition to falling water levels, over-abstraction is causing yield reduction, pump failure in rural water-supply wells, unreliable urban water supplies, land subsidence and drying of wetlands. Of even more concern that depletion however, is groundwater contamination that is affecting the value of the resource base. Contamination with geogenic arsenic and fluoride is widespread in some regions, and in urban areas contamination with sewage and industrial effluents is increasing.

As an open access common property resource there are incentives to over-use groundwater and ignore the costs of resource depletion and damage. Groundwater departments have limited mandates and limited technical and administrative capacity. Financial investment in groundwater governance and management is not commensurate with the resource value, and has focused on development rather than planning, assessment, protection, regulation and management. Inadequate attention has been paid to incentives and community-based groundwater management, and the broader economics of groundwater are poorly understood

India’s groundwater challenge is of an unprecedented scale and complexity. It is not simply a water resources problem, but a multi-sectoral (e.g., agriculture, energy, water, and environment) urban and rural economic development challenge, with different hydrogeological conditions and socioeconomic conditions that will require different sets of solutions.

A comprehensive approach to groundwater development and management is needed. A major new National Groundwater Management Program linking top-down reforms (at the center and state level) and bottom up community based actions is advocated. This program would address policy, regulatory and institutional reforms and technical and administrative capacity limitations, and fill critical groundwater knowledge gaps across key sectors impacted by or impacting groundwater. It would also establish coherent incentives to address the open access groundwater governance challenge and build climate change resilience.

MEETING OBJECTIVES

The Ministry of Water Resources, River Development and Ganga Rejuvenation (MoWR, RD&GR), with support of the World Bank, convened a one-day high-level meeting of senior central and state policy makers, resource managers and invited experts to scope a national groundwater reform program, with the following specific objectives:

- To reach a shared understanding of key groundwater governance challenges
- To learn from national and international examples of good groundwater governance
- To identify and prioritize elements for a national groundwater reform program

MEETING FORMAT

The meeting commenced with remarks from the Chair (Mr Shashi Shekhar, Secretary, MoWR, RD&GR) and the Co-chair (Mr Parameswaran Iyer, South Asia Water Practice Manager, World Bank) followed by three presentations (*Current Groundwater Governance and Management in India*; *Groundwater Reforms in Australia*; and *The Economics of Groundwater in India*). Invited comments and an initial discussion on these presentations ensue, followed by an open plenary discussion on scoping a national program structured around three themes: (i) groundwater knowledge; (ii) planning and regulatory institutions; and (iii) demand management. A final synthesis session agreed on architecture of a reform program. The meeting was closed with concluding remarks from the Chair and Co-chair. The full program is in Annex 1.

PARTICIPANTS

Meeting invitations were sent to senior policy makers and resource managers of relevant central and state government agencies (including water resources, irrigation and finance), as well as relevant academics, NGOs and CSOs, and staff of the World Bank's Global Water Practice. The 52 participants included senior decision makers (at Secretary, Additional Secretary and Joint Secretary level) and others from central and state governments agencies including Andhra Pradesh, Gujrat, Madhya Pradesh, Punjab, Rajasthan, Tamil Nadu, Telangana and Uttar Pradesh. A list of participants in in Annex 2.

OPENING REMARKS

Mr Shashi Shekhar (Secretary, MoWR, RD&GR) opened the meeting by thanking the World Bank for its support and welcoming participants. He underscored the meeting objective to brainstorm on the needs for and elements of a national groundwater reform program. He noted India's heavy dependence on groundwater given the lower reliability of most surface water supplies, and noted this dependence is likely to grow given climate change and increasing demand. He asked "what should our approach be toward managing this key water resource, which has been treated as a "poor cousin" of surface water?" He queried "why is water quality becoming a more serious problem now; is over-pumping inducing water quality deterioration from naturally occurring geogenic contaminants?" He highlighted the inequity when

rich farmers can dig deeper and deeper wells, while those poor farmers are drying up. He noted the need to consider capacity building and artificial recharge options, as well as pilot reforms for replication and scaling up. He invited state water resources / irrigation and finance Secretaries to consider how governments could collectively promote a paradigm shift to sustainable groundwater development and management, but as a component of the integrated management of surface and groundwater resources.

Parameswaran Iyer (South Asia Water Practice Manager, World Bank) suggested the meeting go beyond technical issues and focus on policy needs, institutional reforms and capacity strengthening needs. He requested state government and Central Groundwater Board advice on design of a National Groundwater Program and encouraged the meeting to develop a roadmap.

NATIONAL AND INTERNATIONAL PERSPECTIVES

Groundwater Governance and Management in India

Mr. KB Biswas (Chairman, Central Groundwater Board) provided an overview of the groundwater situation in India addressing: (i) groundwater scenario, (ii) groundwater challenges, (iii) current governance, (iv) management strategies and initiatives and (v) groundwater reforms. The presentation can be accessed at www.indiawrm.org.

Groundwater in India occurs in the alluvial Indo-Gangetic formation (covering 30 percent of the nation) and hard rock formations (covering 70 percent of the nation). Rapid, unregulated groundwater development over the last five decades has meant that by 2011 62 percent of groundwater was developed and 30 percent of units were close to or beyond the safe abstraction pumping limit (classified as semi-critical, critical or over-exploited levels). Higher abstraction levels occur in northwestern plain states (Delhi, Haryana, Punjab and Uttar Pradesh), western arid states (Gujrat, Rajasthan and Daman and Diu) and southern peninsula states (Andhra Pradesh, Goa, Karnataka, Kerala, Pondicherry, Tamil Nadu and Telangana). Factors contributing to groundwater decline include: (i) increased water demand, (ii) increase in water-hungry crops, (iii) full commitment of surface water supplies, (iv) electricity subsidies and (v) rapid urbanization. Groundwater quality deterioration is now widespread: geogenic arsenic is a problem in 86 districts in ten states, fluoride in 276 districts in twenty states, and iron in 297 districts in twenty-one states. Nitrate (an anthropogenic pollutant) is a problem in 387 districts in twenty-one states; heavy metals, pesticides, sewerage, mining and agro-chemicals are important pollutants in various districts.

The National Water Policy calls for an end to over-exploitation of groundwater, promotion of artificial recharge and aquifer mapping to assess extent and quality of groundwater. Under the Indian Constitution water management is primarily a state subject, but only the central government can legislate on environmental matters including promotion of groundwater protection and promotion of sustainable use. Groundwater access is linked to land ownership: land owners have unrestricted right to access groundwater below their land. This limits the central government's ability to regulate groundwater and has contributed to over-exploitation. Seventeen states have enacted laws for regulating groundwater, but none of the states experiencing groundwater depletion have done so. A review has highlighted the following key challenges for groundwater management: (i) inadequate regulatory measures, (ii) limited community participation and (iii) inadequate state capacity and authority to control groundwater use and protect recharge areas.

The 12th Five-year Plan lists key groundwater governance issues for India: (i) the failure to consider aquifers in water resources planning and management, (ii) a tendency to ignore the common pool nature of groundwater, and (iii) the need to decouple groundwater access rights from land ownership. There is

a need to improve coordination amongst central ministries (Water Resources, Urban Development, Rural Development, Agriculture, Environment, Panchayati Raj, Earth Sciences, and Science and Technology) to address groundwater management. CGWB has defined principles for sustainably allocating groundwater and protecting recharges areas, and identified areas for groundwater development. A National Aquifer Mapping program (to define and promote sustainable yields, guide artificial recharge, develop groundwater management strategies and develop location-specific agreements with groundwater users) is being progressed in key states tackling over-exploitation but implementation has been slow. An artificial recharge masterplan has been prepared that identifies recharge areas and water volumes, and the numbers and costs of recharge structures.

CGWB has proposed a cyclic step-wise process for groundwater reform based upon:

1. Scientific information generation to generate models for aquifer-based groundwater development
2. Participatory groundwater management on an aquifer basis
Public sector investment in groundwater
3. Area-specific regulations on tubewell depths and spacing and removal of energy subsidies.

Groundwater Reforms in Australia and NSW: An Overview

Mr David Harris (Australian Water Partnership) described the evolution of water resources development in Australia. The presentation can be accessed at www.indiawrm.org. 1900-1950 was a period of infrastructure development and establishing water legislation; 1950-1980 was a period of economic development based on increasing water use and establishment of a water entitlement system; and from the 1980s on there has been a shift to balancing economic development with social and environmental objectives, with a greater role for the federal government and national water reforms. Development and governance reforms were linked. States were responsible for managing surface and groundwater and water sharing was promoted through interstate agreements. In 2007, the Federal Water Act was passed, and in 2012, and the Murray Darling Basin Plan was finalized. National water policy reforms (part of the Council of Australia Government reforms) promoted reduction in diversions, clearly defined entitlements, separation of water rights from land, removal of barriers to trade, requirements for water planning, and recovery of costs of managing water. In 1994, the National Water Initiative (NWI) was launched and the National Water Commission was established with responsibility for auditing NWI implementation.

In NSW the Water Act (2000) provides the legal basis for issuing groundwater entitlements. Volumetric entitlements were granted for previously authorised areas, extractions are metered, and compliance promoted through hefty fines for violation for corporations (for up to \$2.2million) and for individuals (for up to \$1.1million). Groundwater allocations were guided by groundwater water balance modeling. Groundwater reforms in NSW included new legislation, listing perpetual water licences in the Government register and separating water entitlements from land. Basic landowner rights were established and 10-year statutory water sharing plans were developed with communities. A 942 GL reduction of entitlements in over-allocated aquifers was agreed and free-flowing artesian bores were capped. The federal government role was primarily confined to approving or refusing major developments based on environmental issues and establishing sustainable diversion limits for the Murray-Darling Basin.

Hidden Treasure: Groundwater in India

Mr Richard Damania (World Bank) presented on the economics of groundwater in India using evidence from Andhra Pradesh. The presentation can be accessed at www.indiawrm.org. Mr Damania highlighted that without energy subsidies the many marginal wells are not profitable; fewer wells with less pumping from each is required. Excessive clustered wells impact on the water table and reduces well yields. The trend for deeper wells means not only more expensive wells but greater failure of older wells and reduced

success for new wells. Deeper wells also mean higher energy costs and reduced profit margins. The transition from a vicious to virtuous cycle requires context-specific incentives to over-drill and over-pump.

Investment in artificial recharge may augment supply but would not solve the over-drilling problem. Metering could help control by pumping (by pricing water) and community-based groundwater management can help provide information on local aquifers to inform dry season planting, but application should be based on rigorous evaluation and cost benefit analysis. Bolder collective action solutions might include establishment of groundwater user associations. This would require metering each well, allowing communities to determine allocations based on available water. User associations would determine well spacing within legal limits (e.g., 300 m in Andhra Pradesh), monitor use and sanction breaches. Success would depend on legal enforcement, and this may not be feasible everywhere. Other options include metering use and charging for water. A block pricing structure could include free water for first use block, followed by charging for incremental additional use. Recognizing resistance to pricing the “Brazilian solution” could be considered where payments are made for use below a specified level and charges are levied for use above this level. Other policies could include removal of price subsidies for groundwater-intensive crops (rice, sugarcane and wheat), metering of electricity and charging for use and removal of subsidies for solar powered pumps. Drip irrigation is not a panacea against depletion as farmers may intensify production and sell water to neighbors without tubewells.

OPEN DISCUSSION

Dr Shah (IWMI) commended the Secretary for hosting this first high level government meeting on an important subject for the nation and stressed the vital role groundwater has played in India’s economy and in lifting so many people out of poverty. But he noted that for a common pool resource that was vital for irrigation and water supply, it is important to recognize and address the factors contributing to over-exploitation and poor governance. Controlling over-exploitation is a challenge in many parts of the world. Groundwater development was a response to the failure of public water supply systems confounded by perverse subsidies. The water-energy-food nexus is important to understand. Participatory groundwater management examples exist that should inform proposed national groundwater reforms.

Dr Hirji (World Bank) noted the importance and timeliness of the meeting given the magnitude of the challenge. He noted that addressing India’s groundwater problems with over 30 million wells and different hydrogeological conditions is a highly complex task that will require a long-term view and sustained commitment. Groundwater governance is a challenge in both developed and developing countries with few major success stories. India’s challenges are unique and solutions need to primarily come from within; lessons from outside may be useful but must be adapted to local contexts. Lessons from Australia, for example, with a comparatively small and sparse pollution and limited number of tubewells must be considered in-context. Dr Hirji noted the global trend of the last two decades with an increased focus on water management (e.g., the last six World Water Forums and many international and regional meetings) but limited attention to groundwater. Equally, while funding for water resource research and development has increased dramatically over the last two decades funding for groundwater has shrunk, reflecting the bias of governments and international agencies towards surface water investments that large water infrastructure. Investment in groundwater is typically smaller and less politically attractive. Addressing the groundwater challenge first requires the physical system (the aquifer configurations and linkages with land and surface water) to be well understood. Reforms should be a part of broader water sector reforms and shift the focus from groundwater development to sustainable groundwater management. Policy and legal reforms with sound knowledge and capable institutions must be supported by community-led participatory groundwater approaches and incentives.

Shri R.S. Julania (Principle Secretary, Madhya Pradesh) suggested the meeting generate implementable policy prescriptions. For states, groundwater data are limited and obtaining more reliable data is a high priority. There is a lack of information on the reliability of groundwater for drinking water, on aquifer storage characteristics and on water-logging from groundwater irrigation. The National Aquifer Mapping initiative is very slow. Groundwater development should be pursued in areas where groundwater is under-exploited with a focus on conjunctive management of surface and groundwater and improvements in groundwater use efficiency including via micro irrigation. Deficit crops like paddy should be discouraged and dug wells should be incentivized.

Dr Himanshu Kulkarni (ACWADAM) called for a clear process, a structure to go forward and strategic investments. Science, water user participation and regulatory processes can improve policy and policy implementation. While conventionally policy is used to guide practice, practice can also be used to inform policy – both successful practice but also promising approaches.

Dr S.S. Dhiman (former Chairman, CGWB) noted that the ecological aspects of groundwater have been overlooked. Important questions include: Are our assessments of groundwater adequate? Who are agriculture users and how are they defined? What were the impacts of water resources use? What are the effects of groundwater on health? Who monitors groundwater and who acts on the findings of monitoring results? What is the role of civil society? What about regional aquifers? What are the costs of groundwater management and how should these be met? Do we adequately understand groundwater recharge? Why are some rivers in southern India perennial in spite of brief monsoon rains?

STRUCTURED DISCUSSION

A structured discussion session with input from each participant considered the following questions:

1. What are the key knowledge gaps a national program should fill? Identify hotspots for groundwater management and current and potential solutions.
2. How can planning and regulating Institutions be strengthened both at the center and in the states? Are there opportunities to partner with CSR, academia and other organizations in a national program?
3. How can demand-side management be institutionalized? How to reduce water use, incentivize or regulate water use, introduce metering; incentivize through linkages to other schemes (e.g., PMKSY)?

All participants contributed perspectives that were wide-ranging and covered: (i) data, information and knowledge issues, (ii) water scarcity, groundwater depletion, groundwater pollution, groundwater assessment and aquifer mapping, (iii) conjunctive management, dams and infrastructure, recharge area protection, groundwater conservation, rainwater harvesting and artificial recharge, (iv) agricultural productivity, water-food-energy nexus, (v) community-based groundwater management, groundwater regulation, central and state institutions, capacity building and training, and (vi) groundwater policy and energy subsidies. The key points raised are summarized below.

1. ***A paradigm shift in groundwater governance and management is required.*** Groundwater has been neglected for too long and its management is highly underfunded. Although groundwater has played a key role in the economic and social development of India, the current state of indiscriminate groundwater development has reached a crisis point and urgent reform is required. With climate change surface water will be less reliable and the reliance on groundwater will increase. A paradigm shift is needed that recognizes the criticality of groundwater to India and resources its management appropriately to achieve equity, sustainability and efficiency. Sound groundwater policy informed by science, socio-economics, community-based practice, and supported by a massive public education

campaign is required. New policy should support top-down and bottom-up reforms to (i) promote changes in thinking and behavior of groundwater users, (ii) adequately resource groundwater management including community-based approaches and (iii) establish incentives for sustainable use.

2. **Groundwater data, information and knowledge should be improved.** Groundwater aquifers are complex physical systems. Aquifers differ in their storage capacity, connectivity and recharge mechanisms. Robust understanding of groundwater systems, their characteristics and behaviors is fundamental for its optimal development and management, including design, construction and operation of effective artificial recharge systems. This understanding requires reliable data and information to the foundation for sound groundwater management. While there are existing groundwater monitoring programs and database development initiatives many gaps, inconsistencies and overlaps remain. Central and state agencies should coordinate and synchronize data collection and data and information management (including groundwater levels, driller logs and pump tests, water quality and water use data).
3. **There is no “one-size-fits-all solution”.** Groundwater problems vary between alluvial and hardrock systems and between different states according to use and contamination issues. Therefore, solutions will need to be context-specific. Nonetheless there are common aspects to groundwater challenges and solutions that will warrant common approaches. Groundwater is both a rural development challenge and an urban development challenge and spans multiple sectors including agriculture, energy, health, environment and land. Successful groundwater reforms will need consider and address these multi-sectoral linkages. Aquifers do not necessarily correspond to river basin boundaries, and aquifers often cross jurisdictional boundaries. Optimal development and management of groundwater requires management of the entire aquifer system. Like river basins, this requires joint and cooperative approaches and institutions to manage shared water resources.
4. **Groundwater and surface and groundwater needed to be managed jointly.** Surface and groundwater systems are inter-connected to varying degrees and should be managed jointly to maximize benefits in a sustainable manner.
5. **Massive and wide-reaching public education is required.** A well thought out, well designed, cost effective and properly implemented public education campaign is required to raise awareness of the value of and threats to groundwater, and need for behavior change. Lessons from Swachh Bharat should be adopted while recognizing a key benefit of improved sanitation is reduced groundwater contamination to lever improved good groundwater governance.

An integrated approach to managing groundwater that considers surface water would include:

1. Conjunctive development and management of surface and groundwaters that encompasses rehabilitation and improved management of surface canal systems, and development and operations of dams and other structures for storing and conserving water; rainwater harvesting for recharge including from rooftops via mandatory changes to building codes; and artificial recharge plans (locations, opportunities and designs) based on technical feasibility and economic, environmental and social analysis for priority aquifers.
2. Review, refinement and expansion of systematic monitoring of groundwater level, use and quality, as well as guidelines for community-based groundwater monitoring; groundwater pollution monitoring, assessment and control may including use of remote sensing and multi-parameter and toxicity tests where appropriate; regular groundwater assessments using improved groundwater assessment methods; groundwater models as management tools initially for over-exploited or stressed areas; and training in groundwater modeling (development, calibration and model application).
3. Separation of water access rights from land ownership; review of energy subsidies with a move towards subsidy elimination; a review of policies supporting widespread adoption of solar pumps to

ensure sustainability; promotion of groundwater legislation, regulations and operational guidelines for priority states as well as training programs in groundwater regulation enforcement.

4. Acceleration of national aquifer mapping program and preparation of aquifer management plans for priority aquifers and stressed areas; land and water management to prioritize protection of aquifer recharge areas using a step-wise approach that identifies recharge areas, ensures legal protection, and identifies, empowers and resources the agencies responsible for recharge area protection; assessment and control of waterlogging, salinity and alkalinity in high water table areas.
5. Demand management (including water use efficiency measures), agriculture productivity, wastewater recycling and re-use including for recharge.
6. Establish and strengthen central and state groundwater planning and regulatory bodies, with appropriate enforcement, including stiff fines for violations; develop transparent conflict resolution mechanisms; establish community-based groundwater planning and management institutions.
7. Adequate financing for groundwater studies, tasks, activities and implementation including monitoring, mapping, planning, capacity building and regulations.

KEY REFORM ELEMENTS

1. Conduct a “hot-spot analysis” to:
 - i. Identify and describe key current and emerging groundwater problems across the India
 - ii. Identify key groundwater recharge areas that need protection
 - iii. Estimate sustainable yields or groundwater recharge potential to guide sustainable use levels
 - iv. Identify groundwater-dependent ecological values
 - v. Develop fit-for-purpose reforms at state and local level
 - vi. Prioritize funding assistance
2. Define groundwater management units from aquifer mapping, current and potential use and quality
3. Consider a “program for results” approach with appropriate state-level targets to allocate funding
 - i. Prioritize groundwater development and protection drinking water supply
 - ii. Scope options for metering groundwater use (targeting high priority areas) and institutional arrangements to support this
 - iii. Invest in the protection of groundwater recharge areas
 - iv. Invest in artificial recharge structures where appropriate, considering technical, economic, environmental and social criteria
4. Invest in institutions
 - i. Bottom-up: community level participatory management of surface water and groundwater (SW-GW) possibly supported by CSR contributions
 - ii. Top-down: reorienting center and state groundwater agencies from solely technical to policy, planning, regulatory and implementing agencies
 - iii. Capacity development in technical and policy areas and in groundwater protection and regulation and in community based groundwater management
5. For priority groundwater management units identify a portfolio of incentives and regulations to achieve sustainable levels of use
 - i. Reward staying within sustainable levels
 - ii. Penalize excessive use
 - iii. Remove current perverse incentives/subsidies
 - iv. Appropriately control additional development of groundwater even in safe areas

NEXT STEPS

1. World Bank will prepare comprehensive summary of this meeting including all presentations and will share it via NHP Website: www.indiawrm.org
2. This meeting will inform scoping by MoWR of a potential national GW program
3. National Hydrology Project will provide important contributions to improved GW data, technical capacity and strengthened institutions.
4. This meeting will inform ongoing discussions in MoWR on central institutional reforms to strengthen water resources planning and policy
5. A Regional World Bank study on sustainable GW use is being scoped

CLOSING STATEMENT

The Chair thanked all experts and participants for the many ideas generated. He stressed that state-level interventions will vary but that major reforms are required nation-wide. He acknowledged there is no single solution and that many opportunities must be considered including rainwater harvesting, artificial recharge, groundwater management, more efficient water use including investment via precision irrigation and altered cropping patterns, protection of recharge areas, watershed management, community participation, legislation and regulation, stricter enforcement, energy efficiency, the water-energy-nexus, groundwater institutions, capacity building and improved governance.

India should embark upon reforms that improve groundwater management via a holistic approach. This requires a paradigm shift towards sustainable and equitable groundwater use.

ANNEX 1 – PROGRAM

India Groundwater Meeting: Scoping a National Reform Agenda

September 24, 2015, Le Meridien Hotel, New Delhi

CHAIR: Mr. Shashi Shekhar, Secretary

Ministry of Water Resources, River Development & Ganga Rejuvenation

09:30 – 10:00	REGISTRATION & COFFEE/TEA	
SESSION 1	Setting the Scene	
10:00 – 10:15	Welcome and Opening Remarks	Shashi Shekhar & Parameswaran Iyer
10:15 – 10:30	The Need for National Groundwater Reform	Shashi Shekhar
10:30 – 11:00	Current Groundwater Governance and Management	KB Biswas
11:00 – 11:30	MORNING TEA	
SESSION 2	Economics and International Experiences	
11:30 – 12:00	Groundwater Reforms in Australia	David Harris, Australian Water Partnership
12:00 – 12:30	Economics of Groundwater in India	Richard Damania, World Bank
12:30 – 13:30	Discussion	
13:30 – 14:30	LUNCH	
SESSION 3	Discussion: Scoping a National Program	
14:30 – 15:15	What are the key knowledge gaps a national program should fill: Identify hot spots for Groundwater management; what are known solutions for hotspots today and for the potential ones in future?	
15:15 – 16:00	How to strengthen planning and regulating Institutions both at center and the states: Opportunities to add partners such as CSR, Institutions/Academia, supported by Centralized system?	
16:00 – 16:30	How to Institutionalize demand side management: reduce water use with communities, incentivize or regulate water use, introduce metering/ranking the group; incentivize through linking other schemes (PMKSY)?	
16:30 – 17:00	AFTERNOON TEA	
SESSION 4	Next Steps	
17:00 – 17:15	Summary of the discussion session: the architecture of a reform program	
17:15 – 17:45	Discussion: next steps to progress this reform program	
17:45 – 18:00	Concluding Remarks	Shashi Shekhar & Parameswaran Iyer

ANNEX 2 – LIST OF PARTICIPANTS

Name	Place	Organization
Shashi Shekhar	New Delhi	MoWR, RD&RG, Secretary, Meeting Chair
Parameswaran Iyer	Washington, DC	World Bank, Meeting Co-Chair
Amajit Singh	New Delhi	MoWR, RD&RG, Special Secretary
Amita Prasad	New Delhi	MoWR, RD&RG, Joint Secretary (A & GW)
Manish Kumar	New Delhi	MoWR, RD&GR, Assistant Secretary
Sunil Kumar Verma	New Delhi	MoWR, RD&GR, Assistant Secretary
RK Gupta	New Delhi	MoWR, RD&GR, Director
M Bharani Kumaar	New Delhi	MoWR, RD&GR
Anup Kumar Singh	New Delhi	MoWR, RD&GR
Pratul Saxena	New Delhi	MoWR, RD&GR
Avanish Kant	New Delhi	MoWR, RD&GR, Senior Hydrologist
Rishikesh Singh	New Delhi	Director, DEA, MoF
Avinash Mishra	New Delhi	NITI Aayog
KB Biswas	Faridabad	CGWB, Chairman
E Sampath Kumar	Faridabad	CGWB Member
S Marwaha	Faridabad	CGWB, Regional Director
GC Pati	New Delhi	CGWB
KC Naik	New Delhi	CGWB
RC Jain	New Delhi	NWM, Ex-Chairman, CGWB
Sushil Gupta	New Delhi	NWM, Ex-Chairman, CGWB
SS Dhiman	New Delhi	Ex-Chairman, CGWB
RK Jain	New Delhi	CWC
Vinay Kumar	New Delhi	CWC
Suraj Bhan Singh	Rajasthan	Groundwater Department, Chief Engineer
BK Maheshwari	Rajasthan	Groundwater Department, Superintending Hydrologist
JN Singh	Gujarat	Groundwater Department, Additional Chief Secretary
JK Trivedi	Gujarat	Water Resources Development Corporation
RK Garg	Punjab	Department of Irrigation
Chandra Prakash	Uttar Pradesh	Groundwater Department, Principle Secretary
G Sambaiah	Telangana	Groundwater Department, Director
M Arvind	Tamil Nadu	Finance Department
B Rajeshwari	Tamil Nadu	Groundwater Department
S Raja	Tamil Nadu	Ground & Surface Water Resources Data Centre, Assistant Executive Engineer
RS Julania	Madhya Pradesh	Water Resources, Principal Secretary
NC Ghosh	Roorkee	NIH, Scientist G
Anupma Sharma	Roorkee	NIH
Sudhir Kumar	Roorkee	NIH
Bishwadeep Ghose	Bangalore	Arghyam
Jayamala Subramaniam	Bangalore	Arghyam

Himanshu Thakkar	New Delhi	SANDRP
Himanshu Kulkarni	Maharashtra	ACWADAM
David Harriss	Australia	Australian Water Partnership
Tushaar Shah	Colombo	IWMI
William Young	Washington, DC	World Bank
Richard Damania	Washington, DC	World Bank
Genevieve Connors	New Delhi	World Bank
Anju Gaur	New Delhi	World Bank
Rafik Hirji	Washington, DC	World Bank
Satya Priya	New Delhi	World Bank
C Rajagopal Singh	New Delhi	World Bank
Rajesh Balasubramanian	New Delhi	World Bank
Amit Jain	New Delhi	World Bank